

WHAT IS CLAIMED IS:

Sub
Al
5

1. ~~In a computer system, a method of generating video frames, the method comprising the acts of:~~

receiving first data representing a first video frame, the first data comprising a plurality of elements in a memory in the computer system, each element relating to a group of pixels;

receiving second data representing a second video frame, the second data comprising a plurality of elements in the memory in the computer system, each element relating to a group of pixels;

10 generating third data representing at least one video frame based upon information from the first and/or second data; and

filtering at least a portion of the generated third data by reducing visible discontinuity between adjacent elements in the generated third data.

15 2. The method of Claim 1, wherein the elements are macroblock quadrants having a plurality of rows and columns of pixels, each of the pixels having an associated intensity value.

3. The method of Claim 2, wherein the filtering comprises the steps of:

(i) selecting at least one pixel within a selected macroblock quadrant;

20 (ii) determining the average of the pixel intensity of one or more proximately positioned pixels with respect to the at least one pixel; and

(iii) associating the determined average pixel intensity with the at least one pixel.

25 4. The method of Claim 3, additionally comprising the step of performing the steps (i), (ii), and (iii) with respect to each of the pixels within the selected macroblock quadrant except the bottom-most row of pixels and the right-most column of pixels.

30 5. The method of Claim 4, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned above the at least one pixel, the second bordering pixel being positioned below the at least one pixel.

6. The method of Claim 4, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned to the right of

the at least one pixel, the second bordering pixel being positioned to the left of the at least one pixel.

5 *Sub a2* 7. ~~The method of Claim 2, further comprising the steps of:~~
determining a filter strength; and
selectively filtering pixels in each of the macroblock quadrants based
~~upon the filter strength.~~

10 8. The method of Claim 7, wherein the filter strength is determined on a
macroblock quadrant by macroblock quadrant basis, and wherein the filter strength is
based at least in part on a motion vector that is associated with the respective
macroblock quadrant.

15 *Sub a3* 9. ~~A system for generating video frames, the system comprising:~~
means for receiving first video frame data in a memory in the computer
system, the first video frame data comprising a plurality of elements, each
element corresponding to a group of pixels, the first video frame data
representing a first video frame;

means for receiving second video frame data in the memory in the
computer system, the second video frame data comprising a plurality of
elements, each element corresponding to a group of pixels, the second video
frame data representing a second video frame;

20 means for generating at least one intermediate video frame based upon
information from the first video frame data and/or the second video frame data,
the at least one intermediate video frame representing at least one selected
element at a position intermediate to respective positions whereat the element is
represented by the first video frame and the second video frame; and

25 filter means for reducing visible discontinuity between at least two
~~adjacent elements in the at least one generated intermediate video frame.~~

17 10. The system of Claim 9, wherein each of the elements are macroblock
quadrants having a plurality of rows and columns of pixels, each of the pixels having an
associated intensity value.

20
11.

16
The system of Claim 9, wherein the means for filtering includes:

(i) means for selecting at least one pixel within a selected macroblock quadrant;

5 (ii) means for determining the average of the pixel intensity of one or more proximately positioned pixels with respect to the at least one pixel; and

(iii) means for associating the determined average pixel intensity with the at least one pixel.

21
12.

20
The system of Claim 11, additionally comprising performing steps (i), (ii), and (iii) with respect to each of the pixels within the selected macroblock quadrant except the bottom-most row of pixels and the right-most column of pixels.

10

22
13.

20
The system of Claim 11, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned above the at least one pixel, the second bordering pixel being positioned below the at least one pixel.

23
14.

15

20
The system of Claim 11, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned to the right of the at least one pixel, the second bordering pixel being positioned to the left of the at least one pixel.

Sub
a4

20

15. ~~The system of Claim 10, further comprising:~~

~~means for determining a filter strength for the filtering act; and~~

~~means for selectively filtering pixels in the macroblock quadrants based~~

~~upon the filter strength.~~

19
16.

25

18
The system of Claim 15, wherein the filter strength is determined on a macroblock quadrant by macroblock quadrant basis, and wherein the filter strength is based at least in part on a motion vector that is associated with the macroblock quadrant.

Sub
a5

30

17. ~~A video presentation, comprising:~~

~~first frame data in a memory in the computer system, the first frame data representing a first video frame, the first frame data comprising a plurality of elements, each element corresponding to a group of pixels;~~

~~second frame data in the memory in the computer system, the second frame data representing a second video frame, the second frame data comprising a plurality of elements, each element corresponding to a group of pixels; and~~

intermediate frame data representing an intermediate video frame between the first and second video frames, the intermediate frame data based upon information from the first and second frame data, the intermediate video frame representing at least one selected element at a position intermediate to respective positions whereat the selected element is represented by the first video frame and the second video frame, and wherein at least a portion of the intermediate video frame has been filtered to reduce visible discontinuities between elements.

27 18. The video presentation of Claim 17, wherein each of the elements is a macroblock quadrant having a plurality of rows and columns of pixels, each of the pixels having an associated intensity value.

28 19. The video presentation of Claim 18, wherein the intermediate video frame was filtered by a filtering process comprising the steps of:

(i) selecting at least one pixel within a selected macroblock quadrant;

(ii) determining the average of the pixel intensity of one or more proximately positioned pixels with respect to the at least one pixel; and

(iii) associating the determined average pixel intensity with the at least one pixel.

29 20. The video presentation of Claim 19, wherein the video presentation was additionally filtered by the steps (i), (ii), and (iii) with respect to each of the pixels within the selected macroblock quadrant except the bottom-most row of pixels and the right-most column of pixels.

30 21. The video presentation of Claim 19, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned above the at least one pixel, the second bordering pixel being positioned below the at least one pixel.

31 22. The video presentation of Claim 19, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned to the right of the at least one pixel, the second bordering pixel being positioned to the left of the at least one pixel.

35
23.

A system for generating video frames, the system comprising:
a processor;
a memory;

5 a decoder running on said processor, said decoder outputting to said memory first digital data representing a first film frame, said decoder outputting to said memory second digital data representing a second film frame; and

10 a frame generator running on said processor, the frame generator inputting said first digital data and said second digital data, the frame generator outputting to said memory intermediate digital data representing an intermediate film frame based upon information within said first and second digital data, said intermediate digital data including identified groups of pixels, said frame generator reducing visible discontinuities near the perimeters of at least one of the groups of pixels included in said intermediate digital data.

15 *Sub
all* 24. A ~~program storage device, storing instructions which, when executed,~~
perform the steps comprising:

receiving first data representing a first video frame, the first data comprising a plurality of elements in a memory in the computer system, each element relating to a group of pixels, the first data representing a first element at a first position in the first video frame;

20 receiving second data representing a second video frame, the second data comprising a plurality of elements in the memory in the computer system, each element relating to a group of pixels, the second data representing the first element at a second position in the second video frame;

25 generating third data representing an intermediate video frame based upon information from the first and/or second data, the third data representing the first element at a position intermediate to the first and second positions; and

filtering at least a portion of the intermediate video frame by reducing visible discontinuity between the first element and an adjoining element.

30 *39* 25. The program storage device of Claim *38* 24, wherein each of the elements is a macroblock quadrant, each of the macroblock quadrants having a plurality of rows and columns of pixels, each of the pixels having an associated intensity value.

40
26. The program storage device of Claim 25, additionally comprising instructions which, when executed, perform the steps comprising:

- (i) selecting at least one pixel within a selected macroblock quadrant;
- 5 (ii) determining the average of the pixel intensity of one or more proximately positioned pixels with respect to the at least one pixel; and
- (iii) associating the determined average pixel intensity with the at least one pixel.

41
27. The program storage device of Claim 26, additionally comprising instructions that when executed perform steps (i), (ii), and (iii) with respect to each of the pixels within the selected macroblock quadrant except the bottom-most row of pixels and the right-most column of pixels.

42
28. The program storage device of Claim 26, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned above the at least one pixel, the second bordering pixel being positioned below the at least one pixel.

43
29. The program storage device of Claim 26, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned to the right of the at least one pixel, the second bordering pixel being positioned to the left of the at least one pixel.

Sub 27
30. ~~The program storage device of Claim 25, additionally comprising instructions that when executed perform the steps:~~

~~determining a filter strength; and~~

25 ~~selectively filtering pixels in the macroblock quadrants based upon the filter strength.~~

45
31. The program storage device of Claim 30, wherein the filter strength is determined on a macroblock quadrant by macroblock quadrant basis, and wherein the filter strength is based at least in part on a motion vector that is associated with the macroblock quadrant.

Sub 30
32. ~~In a computer system, a method of generating frames, the method comprising the acts of:~~

receiving a first frame in a memory in the computer system, the first frame representative of a digital image at a first time, the first frame including a plurality of macroblocks, each of the macroblocks having four quadrants with a plurality of rows and columns of pixels, and each of the pixels having an associated intensity value;

receiving a second frame in the memory in the computer system, the second frame representative of the digital image at a second time, the second frame including a plurality of macroblocks, each of the macroblocks having four quadrants with a plurality of rows and columns of pixels, and each of the pixels having an associated intensity value;

generating at least one intermediate frame based upon the macroblock quadrants in the first and/or second frames, the at least one intermediate frame representative of an intermediate position of one or more selected macroblock quadrants in the first frame and/or the second frame;

determining a filter strength;

selectively filtering pixels in the macroblock quadrants based upon the filter strength;

determining the average of the pixel intensity of one or more proximately positioned pixels with respect to each of the selected pixels; and

associating with each selected pixel the respective determined average pixel intensity.

49/32. The method of Claim 32, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned above the at least one pixel, the second bordering pixel being positioned below the at least one pixel.

50/34. The method of Claim 33, wherein the proximately positioned pixels include two bordering pixels, the first bordering pixel being positioned to the right of the at least one pixel, the second bordering pixel being positioned to the left of the at least one pixel.

51/35. The method of Claim 32, wherein the filter strength is determined on a macroblock quadrant by macroblock quadrant basis, and wherein the filter strength is based at least in part by a motion vector that is associated with the macroblock quadrant.

Sub
a9

36.

~~A method of generating frames, the method comprising:~~

~~receiving a first frame having a set of elements, the elements collectively defining a digital image;~~

~~generating a second frame using the set of elements from the first frame,~~

5

~~the second frame representative of the first frame at a point in time either before or after the first frame, the second frame representing at least one of the elements at a position different than the position at which it was represented by the first frame; and~~

10

~~filtering the second frame to reduce visible discontinuities in at least one region including adjoining elements.~~

37. ~~A system for generating video frames, the system comprising:~~

~~a frame analysis module for receiving frames; and~~

~~a frame synthesis module for generating at least one frame between two~~

~~received frames, the frame synthesis module filtering the generated frames.~~

Sub
B9

15

Add
a-10

ADD
B14